LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Radio-tellurium.

IN an article in the issue of NATURE for February 11 Mr. F. Soddy gave some account of certain of the results of my investigations with regard to radio-tellurium. In this he criticised somewhat severely my choice of a name for the radio-active substance. He holds the substance investigated by me to be identical with polonium, and even goes farther than Madame Curie herself, who, in her recently published "Dissertation," characterises the use of a new name for the substance as premature.

In a paper published by me in the *Berichte der deutschen chemischen Gesellschaft* in September last, I have already given the reasons which have induced me to propose the name radio-tellurium "provisionally" (vorläufig). Mr. Soddy has not discussed these reasons, although he has had the opportunity of making himself acquainted with my communication before writing his criticism. As the question has once been raised before the readers of NATURE, however, it might be of advantage to discuss it here somewhat more fully.

Shortly after the discovery of polonium by M. and Madame Curie, Giesel found that this substance quickly lost its radio-activity, and he characterised it therefore as inducedly active bismuth. P. and S. Curie themselves had, indeed, shortly before the publication of my first paper on the subject, defined polonium as "une espèce de bismut actif." The observations of Giesel and the Curies differ from one another on two points. Giesel's polonium emitted α and β rays and lost its activity within a few weeks, while that of the Curies sent out only α rays, and lost the greater part of its activity only after the lapse of a few months. More recently Giesel has shown that bismuth by prolonged immersion in a solution of pure radium bromide can become permanently (?) active, and then emits only α rays.

Hence there exists with certainty an inducedly active bismuth giving out only α rays, and this might with accuracy be called polonium. There exists, further, a bismuth giving out α and β rays—Giesel's polonium. In this I have found traces of radio-tellurium, and I have shown that after the removal of the latter the remaining substance shows strong β and diminished α radiations. Finally, after the discovery of radio-tellurium, Madame Curie has purified her polonium by fractional precipitation of the subnitrate, and has ultimately arrived at a substance, of which she describes precipitates, the properties of which agree neither with those of bismuth nor with those of radio-tellurium. This substance she calls polonium. It can be seen from this brief summary that the idea associated with the name polonium is an extremely variable and indeterminate one.

In the investigation of bismuth separated from Joachimsthal pitchblende in an essentially different way from Madame Curie,[1] I found a small quantity of tellurium which was extraordinarily active. From one kilogram of bismuth I was able to separate only about a tenth of a gram of tellurium. This had not previously been found in the pitchblende.

Since the substance was distinguished from ordinary tellurium at first only by its radio-activity, I named it radio-tellurium "provisionally." To give a final name to it seemed to me to be premature. The example of polonium showed clearly enough the confusion arising from giving a permanent name to a thing before the thing itself has been accurately defined. Hence Madame Curie can least of all afford to reproach me with being too hasty in my naming.

The further investigation of radio-tellurium showed how necessary was my caution, for it proved that the substance consisted mainly of ordinary tellurium. It was possible, however, to separate, in a quantity amounting at most to a few tenths of 1 per cent., a radio-active substance of extremely high activity in proportion to its quantity. This substance, of which up to the present I possess only a few milligrams, I have named radio-tellurium "provisionally." Ought I, as Mr. Soddy seems to suggest, to call it also polonium, and so increase the present confusion?

Mr. Soddy appears to wish the justification for a new name to depend on the proof of the constancy of radio-activity of my substance. This suggestion of Mr. Soddy's was not necessary to induce me to pursue experiments in this direction. Such are already undertaken in the most accurate manner, but their results, which must be waited for, have not the least to do with the question of nomenclature. The name polonium does not denote a particular substance which has the property of losing its radio-activity with the course of time—who could at present be sure of the constancy of activity of radium?—but merely radio-active bismuth. So far as the constancy of the radio-tellurium emission is concerned, I may here cite the following experiment. A copper plate of about 8 square cm. surface, on which not more than a few hundredths of a milligram of the purest radio-tellurium have been precipitated, now, after nine months, radiates so powerfully that the phosphorescence of zinc blende and of barium platinocyanide can be made visible to an audience of several hundred people.

Mr. Soddy has thought fit towards the close of his article to attribute to certain German organic chemists the custom of "rechristening well-known bodies." In a way that can hardly be misunderstood, he insinuates that this may be traced to an endeavour to claim for themselves the discoveries of others.

This somewhat objectionable charge Mr. Soddy has in no way shown to be grounded. Polonium can, indeed, hardly be reckoned as one of the well-known bodies.

I can also the more easily refrain from answering this aspersion as I am aware that some of the most prominent English chemists have a quite different opinion of their German colleagues from that of Mr. Soddy. I would recommend in this direction a perusal of Prof. P. F. Frankland's address to the chemical section of the British Association in 1901.

W. MARCKWALD.

PROF. MARCKWALD'S communication will probably be welcomed by the scientific world on account of the opportunity it affords of settling finally the disputed question as to the nature of the body named by him "radio-tellurium." In my own mind, before I had read Prof. Marckwald's letter, a doubt still lingered as to the identity of the body with Madame Curie's polonium on account of the very definite statement made by Prof. Marckwald in his first communication on the subject that the activity of his body did not decay with the time. This to me was an insuperable difficulty in the way of considering the two bodies to be identical. The other reasons Prof. Marckwald has advanced—and it is not likely I should have ventured to express an opinion without having made myself acquainted with these reasons—seemed to arise out of a misconception on the part of Prof. Marckwald himself as to the nature of polonium. This point I hope to discuss later, but first I wish to deal with the, to me, important question of the constancy of the radio-activity of radio-tellurium. It is satisfactory to learn that accurate determinations are in progress. Everyone will understand that the results must be waited for. What I did not appreciate before reading Prof. Marckwald's letter was that his conclusion that the activity of radio-tellurium did not decay with time was merely an impression unsupported by actual measurements.

The experiment quoted, that a sample of radio-tellurium after nine months still illuminates a phosphorescent screen brightly, would seem to illustrate my point that Prof. Marckwald even now seems to be under a misapprehension as to the nature of polonium. After nine months, polonium, according to the work of its discoverer, would still possess at least one-half of its initial activity. I suppose no one would maintain that it is possible to remember over a period of nine months the various degrees of luminosity, produced by a radio-active preparation, with sufficient accuracy to be sure of a diminution by one-half of the initial luminosity during that interval. In two or three years the decay of activity of polonium should

[1] Madame Curie has recently published her method of separation. I separated the bismuth from the pitchblende by precipitating it as oxychloride by the addition of much water to the hydrochloric acid solution.

be obvious even with this rough test, but it certainly would not be sufficiently marked in nine months. We may therefore take it as settled that there is absolutely no evidence at the present time for supposing that radio-tellurium possesses a more constant radio-activity than polonium. If only this point has been made clear this correspondence may be considered to have justified itself.

According to Prof. Marckwald the idea associated with the term polonium is an extremely variable and indeterminate one. It seems to me that this is to put a wrong valuation on the work of its discoverer. Madame Curie gave the name to the hypothetical constituent of the bismuth separated from Joachimsthal pitchblende which caused its radio-activity. The radio-activity in question is distinct from that of any known radio-active substance, for it comprises only the emission of the α or non-penetrating type of radiation. Moreover, it slowly decays with time, and diminishes to half the initial value in about a year. Madame Curie has always been careful to point out that she has not succeeded in separating polonium from bismuth, or in obtaining any spectroscopic or other more direct proof of its existence. The name polonium applies to the body *causing this particular kind of radio-activity*. Hundreds of workers, I suppose, have obtained from the Société de Produits Chimique de Paris specimens of polonium prepared by Madame Curie's method, and have satisfied themselves by their own observations as to the character of its radio-activity. Now Prof. Marckwald has never claimed that he has isolated his body radio-tellurium, although he has been more fortunate than Madame Curie in effecting its concentration. Hence the name radio-tellurium applies also to the hypothetical constituent causing the radio-activity rather than to the preparation itself. Many, no doubt, have obtained also specimens of radio-tellurium from the firm of Dr. Sthamer, of Hamburg, and have compared its properties with those of polonium.

The meaning applied by Prof. Marckwald to the word polonium may be illustrated by these sentences quoted from his letter. "Shortly after the discovery of polonium Giesel found that this substance quickly lost its radio-activity. . . ." "Giesel's polonium emitted α and β rays and lost its activity within a few weeks." "In this (Giesel's polonium) I have found traces of radio-tellurium, and I have shown that after the removal of the latter the remaining substance shows strong β and diminished α radiation."

The question at issue is therefore a very simple one. Is Prof. Marckwald justified in applying Madame Curie's name to Prof. Giesel's preparation? "Giesel's polonium," according to Prof. Marckwald's statement, is a mixture of two radio-active constituents:—(1) radio-tellurium, (2) a constituent giving β as well as α rays. The latter, since it can neither have been polonium nor radio-tellurium, need not be further considered in the present discussion. It *may* be something new and interesting, but, on the other hand, there is nothing to show that it was not merely a trace of radium present as an impurity. In either case it does not concern us, and two bodies only, Madame Curie's polonium and Prof. Marckwald's radio-tellurium, need be further considered. Both are obtained from the same variety of pitchblende, both are distinguished from all the other radio-elements by the fact that they only give α rays, and both possess at least a considerable fraction of their initial activity after the lapse of one year. Now Prof. Marckwald used the same[1] raw material as Madame Curie, namely, the bismuth extracted from the Joachimsthal pitchblende. Since he states that his method separated *all* the active constituent we may feel certain (1) that radio-tellurium must certainly contain polonium; (2) that as it gives no β rays it contains none other of the known radio-active elements; (3) that as the radio-active properties of the two preparations are indistinguishable the active constituent of Prof. Marckwald's preparation is the same as that of Madame Curie's preparation, and therefore by every recognised canon should be termed polonium.

Prof. Marckwald's work has shown that there are present on a maximum estimate 4 milligrams of the active constituent in two tons of pitchblende, or in 8 kilograms of the bismuth salt separated from it. Hence what possible bearing can such a small trace of substance have upon the analytical reactions of the relatively vast bulk of the raw material? In laying stress on these reactions he frequently seems to apply the term polonium to Madame Curie's preparation rather than to its radio-active constituent.

The same criticism might be applied to the following sentence, to be found in his most recent communication (*Berichte*, 1903, p. 2665). "Whether this Curie's polonium does not perhaps contain also some radio-tellurium is a question which must be left to the discoverers of polonium."

With regard to the view expressed that polonium is merely radio-active bismuth, or inducedly active bismuth, in support of which an opinion once expressed by Madame Curie is quoted, the answer, of course, is that Prof. Marckwald's own subsequent work has shown otherwise. By the experiment of depositing on a stick of pure bismuth the whole of the polonium present in a solution, he makes it evident that the latter cannot be bismuth. Those who are acquainted with the work of Rutherford in 1900 on "induced" activity know that the whole conception of radio-active induction has been built up on a simple misconception of the phenomena it is designed to explain. The conception had its origin in the belief that the *rays* from a radio-active substance could excite radio-activity in otherwise inactive matter, which was not in accordance with the facts known at the time it was put forward.

Giesel repeated the identical experiment of Prof. Marckwald with a solution of pure radium, and found that a stick of bismuth after immersion becomes permanently (?) active and then only emits α rays, and Prof. Marckwald, in spite of his own work, concludes that there exists with certainty an inducedly active bismuth giving only α rays, which might with accuracy be termed polonium. He, however, omitted to state that Giesel obtained the identical result if a stick of platinum or palladium were immersed in the radium solution. Hence it might be argued that there exist an inducedly active platinum and an inducedly active palladium, both of which might with accuracy be termed polonium. The alchemists considered that they had turned iron into copper by means of a solution of blue vitriol, until it was pointed out that the latter substance contains copper. It has never been shown that any of the effects of the so-called "radio-active induction" are really due to the conversion of an inactive element into radio-active matter. From the existing evidence to the contrary, it would seem more reasonable to suppose that they admit of a similar interpretation to that now adopted to explain the cuprification of iron.

FREDERICK SODDY.

[1] The point raised in the footnote to Prof. Marckwald's letter is, I take it, a side issue. He brings forward no evidence that the bismuth separated from the pitchblende by sulphuretted hydrogen (Curie) is different in its radio-active properties from that separated by himself as oxychloride, nor any reason for supposing that the active constituent in the two cases might be expected to be different. It is true that his bismuth contained a minute proportion of ordinary inactive tellurium, which was probably almost or quite absent in Madame Curie's preparation. This fact he made use of as the basis of his elegant method of concentrating the active constituent, and he seems to have at first confused the difference of behaviour of the two raw materials to differences in the chemical nature of the active constituents rather than to the fortuitous presence of a trace of tellurium. But his own later experiments (*Berichte*, 1903, p. 2663) show that when the tellurium is removed from the solution his methods of precipitating the active constituent completely fail, but again work perfectly if a few tenths of a milligram of ordinary telluric acid in aqueous solution are added.

Dependence of the Ionisation, produced by Röntgen Rays, upon the Type of the Rays.

MR. EVE, in his letter in NATURE of March 10 (p. 436), shows that the relative amount of ionisation produced by Röntgen rays in different gases depends upon the "hardness" or penetrating power of the rays. I have lately been investigating this question of the dependence of the relative ionisation upon the type of rays, and an abstract of a preliminary paper on the subject appeared in a report of the proceedings of the Cambridge Philosophical Society in the number of NATURE issued on February 18 (p. 383). These experiments, along with later ones, show that the relative ionisation in different gases depends upon the type of rays used. I used a balance method, balancing the ionisation in each gas against that in air. The pressure of the gas in the Röntgen ray bulb was varied, thereby varying the "hardness" of the rays, and it was found that in the case of gases in which the ionisation is greater than in air the ionisation in these gases decreases relatively to that in air